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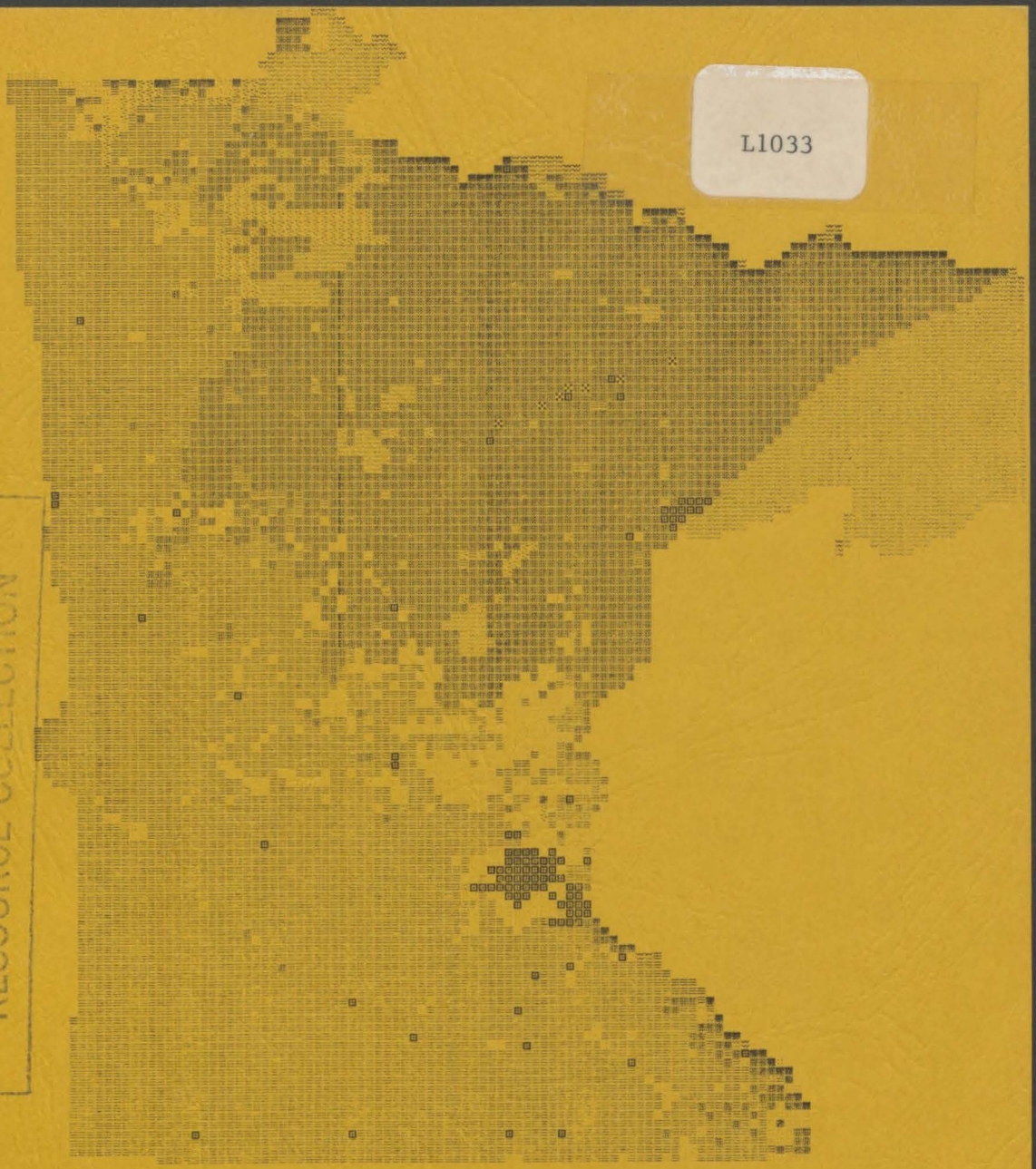

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MINNESOTA LAND MANAGEMENT INFORMATION SYSTEM

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STATE PLANNING AGENCY

MLMIS
GEOCODING PROCEDURES

4005

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Costs of printing this report were born by the state's Intergovernmental Information Systems Advisory Council (IISAC). In large part this report documents the work done by IISAC's Geocoding Committee. This committee has since been absorbed into IISAC's Computer Assisted Assessment and Land Records Committee which is further developing the usefulness of the standards presented here.

A special word of thanks must be given to Professor Jesse Fant, Department of Civil and Mineral Engineering, University of Minnesota, who explained away much of the confusion of the Public Land Survey.

TABLE OF CONTENTS

MLMIS GEOCODING PROCEDURES

I. INTRODUCTION

The Minnesota Land Management Information System (MLMIS) is building a computerized data file of Minnesota's land resources. Physical characteristics, relative accessibility of parcels to market, and information on current land use, zoning and ownership patterns is being collected, coded, and entered into a computer file for every parcel of land in the state. The basic unit for collection of data is the 40 acre parcel -- the smallest subdivision of the original Public Land Survey (PLS) of the state. There are 1.36 million such parcels in Minnesota.

The Public Land Survey was chosen to provide the spatial unit for data collection over other grid systems for several reasons. The Land Survey was made before settlement and served as the basis for allocating land in the territory. Thus, public records of ownership and taxation were indexed by the PLS designation. Even to this day, patterns of ownership, land use, development, and zoning still reflect the original survey lines. In areas where parcel ownership became more and more fragmented from the 40 acre blocks, the parcels can still be aggregated back to the original 40. Since the PLS forms the basic "building block" of man's impact, it is an ideal grid system for matching cultural information to physical resources.

MLMIS has developed a numerical code scheme based on the PLS for assigning computerized data records to land parcels and for correctly locating the data in map output files. The code is a geographic reference, hence the name geocode.

Another type of geocode is important in the development of an information system. This is a geopolitical code used to reference the political subdivision in which each parcel is located. Political subdivisions include counties, minor civil divisions (MCD),[1] school districts, and legislative districts. MLMIS has established a cross-reference to the various geopolitical codes, thus facilitating the merger of a wide variety of administrative data gathered by political units and/or the Bureau of the Census with the basic resource data referenced by the PLS grid.

The procedure for assigning a geocode to each parcel in the information system is the topic of this report. Part II is a brief discussion of the history and structure of the Public Land Survey. Part III details the MLMIS code format used to arrange parcels in the computer. Part IV discusses the coding procedures for identifying the geopolitical attributes of parcels.

The coding schemes detailed in this report have been implemented by MLMIS as working solutions to the geocoding problem. In view of the lack of uniformity among existing geocodes employed by various agencies and units of government, it is hoped that a common coding scheme among all concerned parties will eventually be implemented. IISAC (Intergovernmental Informaton Systems Advisory Committee), a body created by the state legislature, has developed a system for the identification and coding of land ownership in Minnesota based upon the MLMIS system for identifying 40's. IISAC has proposed this system as a statewide standard. The American National Standards Institute (ANSI) is developing a standard set of geopolitical codes for all types of places. Once ready, it will be adopted as a federal standard. MLMIS will follow suit by adopting this code as well.

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[1] The term minor civil division refers to a political subdivision of a county, usually a city or township.

II. PUBLIC LAND SURVEY (PLS)

A. Background

The United States Public Land Survey was authorized by the Continental Congress in 1785. It is a system of rectangular grids established by the federal government for administration, survey, and transfer of title under the public land laws of the United States. The system is used in Minnesota and in all states except the original thirteen plus Kentucky, Maine, Tennessee, Texas, Vermont, and West Virginia.

The surveying of Minnesota took place much later in two separate efforts. Minnesota east of the Mississippi River was included in the survey beginning in 1848 based on the Fourth Principal Meridian. The remainder of the state was surveyed beginning in 1852 based on the Fifth Principal Meridian (Figure 1). The two surveys were conducted simultaneously until 1900.[2] The original township maps, drawn from survey notes, are on file in the Minnesota Secretary of State's office in the state capitol.

The survey system is a grid of north-south lines, called meridians, and east-west lines, called parallels. Meridians and parallels intersect at right angles to form a grid system of six mile square areas called townships. Each township is uniquely identified by township and range numbers which identify row and column placement (see Figure 1). Range (column) numbers are assigned to each grid zone east and west of the principal meridian. Township (row) numbers are assigned to each grid zone north and

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[2] The survey based on the Fourth Principal Meridian includes Wisconsin and part of Illinois. The survey based on the Fifth Principal Meridian includes Missouri, Iowa, and the eastern Dakotas.

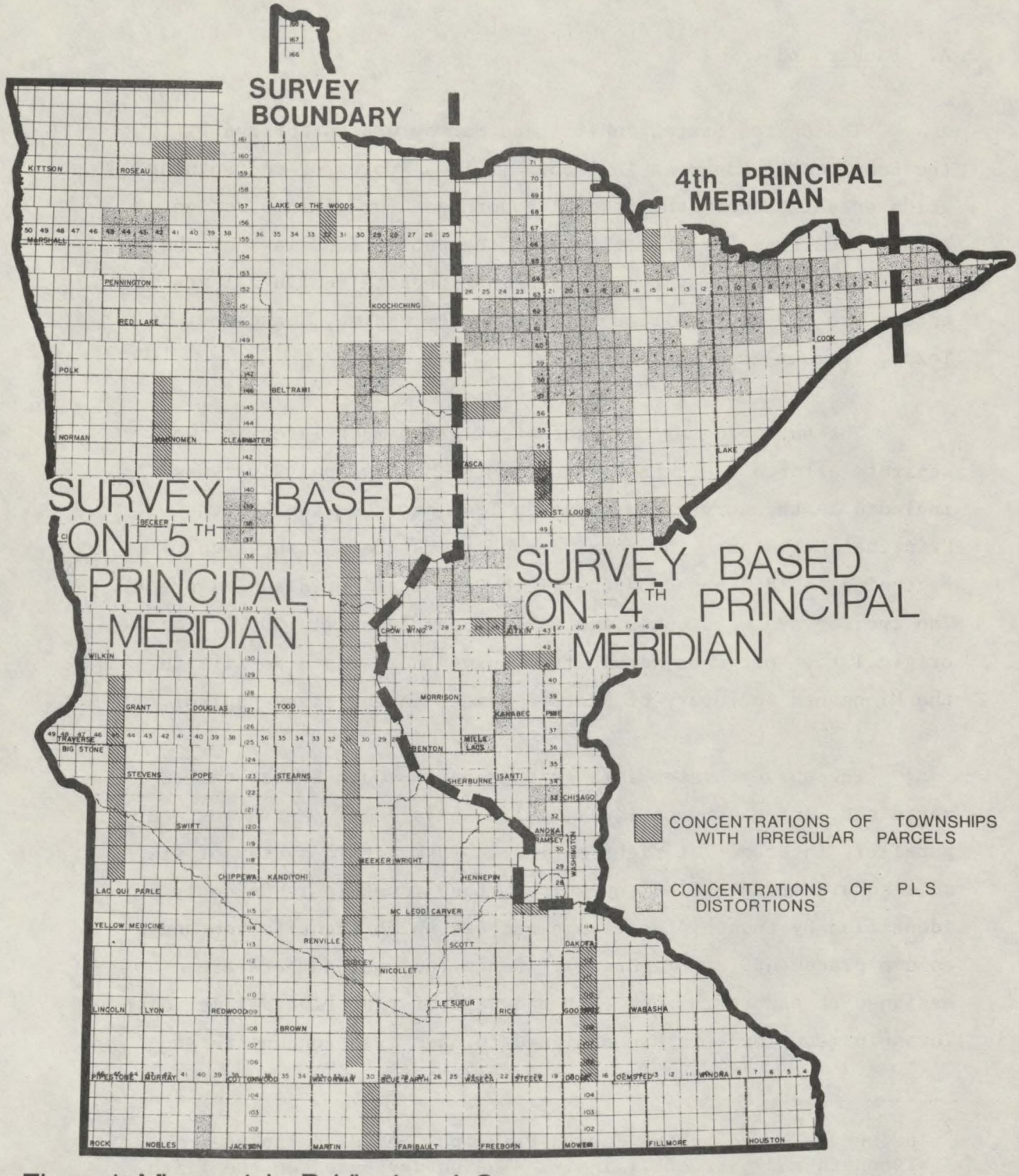

Figure 1: Minnesota's Public Land Survey

south of a selected parallel called the base line.

The Fourth Principal Meridian cuts through the northeast corner of Minnesota and serves as the origin for that survey. The Fifth Principal Meridian lies in the western part of Wisconsin. Thus, most of the townships in Minnesota are numbered to the west of their origin. The minimum and maximum range numbers within the state are 1 and 41, respectively, with a suffix letter added to indicate direction east (E) or west (W) from the principal meridian. The minimum and maximum township numbers in Minnesota are 26 and 168, respectively. All townships lie north of their baseline, so no letter is necessary to designate their north/south direction.

B. Township Subdivisions

Areal units of land surveyed in the PLS are arranged in a hierarchical fashion ranging from the largest units (townships) to the smallest, the regular "40" and various types of government lots.

Each normal or regular township is subdivided into 36 sections, each section being normally one mile on a side. Figure 2 indicates both the method of subdividing the township and of numbering the 36 sections.

Figure 2: Township Section Numbering

Rxx

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Tyy

Sections are further subdivided by two different methods: section quartering and government lots. Either method yields a unit called a parcel in the MLMIS system. Section quartering occurs in two levels. The first quartering of a section generates quarter sections; the second generates quarter-quarter sections. A quarter-quarter section contains 40 acres and measures one-quarter mile on each side. It is commonly called a "40." Each section contains 16 such "40's" and, therefore, each regular township contains 576 "40's."[3] Figure 3 illustrates this quartering methodology. The shaded area in Section 17 is identified as follows: SW Quarter of NE Quarter of Section 17 of T3N, R2W.

Another subdivision of the section is the government lot. The fact that a parcel is a government lot does not indicate that the parcel is owned by the government, but only that it has been individually surveyed. Government lot numbers were assigned in the original land survey to parcels that were not 40.0 acres or where exact dimensions were required. Government lots are commonly found along rivers and lakes and along the northern and western tiers of townships. They also appear along important boundaries; e.g., Indian reservations or the edge between two surveys. The numbering of these lots repeats in each section, starting with government lot number one and continuing until all lots have been numbered.

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[3] A careful examination of Figure 1 reveals that every township does not contain 576 "40's." Some townships are truncated by state or national boundaries. Townships along the boundary between the two surveys are also reduced in size.

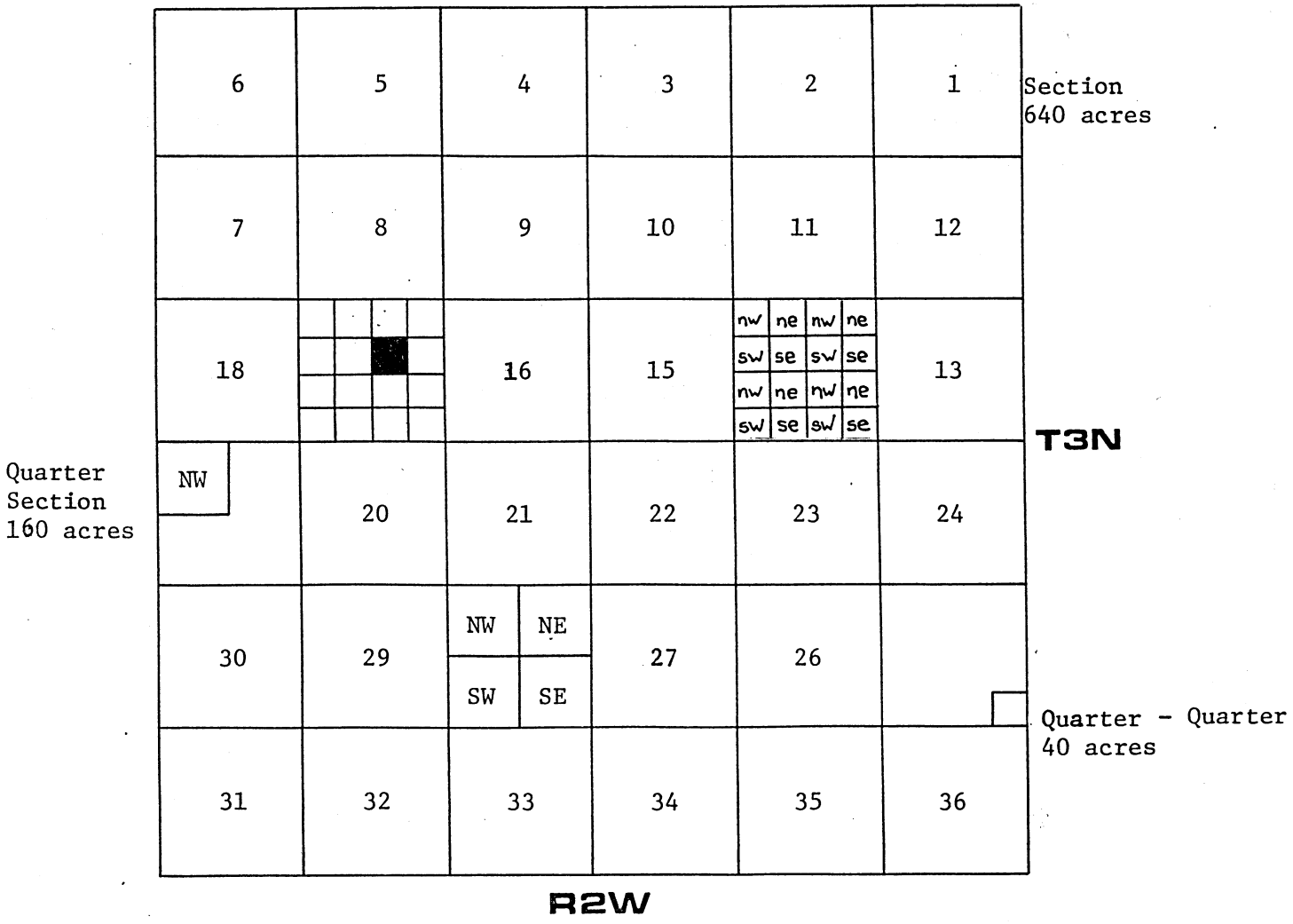

Figure 3: Subdivisions of a Township

Lakes and rivers that were surveyed in the original land survey are adjoined by government lots and are referred to as meandered lakes and rivers. Meandered, in this case, does not refer to the twisting, turning configuration normally associated with the term "meandered," but only to the fact that the river or lake adjoins surveyed government lots. Figure 4 is an example of legal description of a section containing a meandered lake.

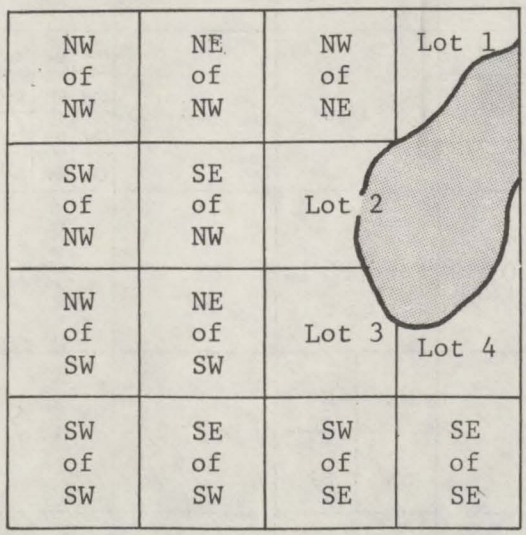

Figure 4· Government Lots on Meandered Lakes

Parcels along the northern and western edges of townships are generally not exactly 40.0 acres because of the convergence of longitudinal lines. Township subdivisions were usually surveyed starting in the southeast corner. Regular parcels were laid out until the surveyor approached the far township borders. The remaining space between regular townships was surveyed and the resulting parcels were assigned government lot numbers. Figure 5 shows an example of this type of government lot.

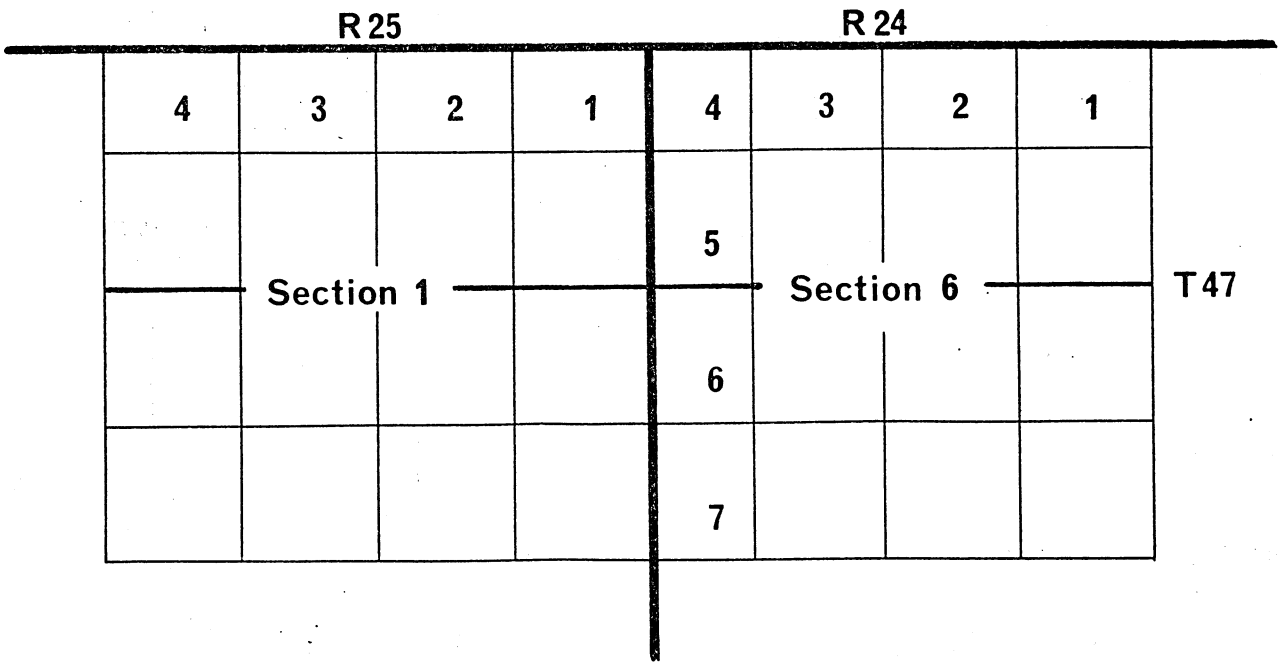

Figure 5: Government Lots on Township Borders

On some occasions, especially when meridian correction jogs were necessary, the distances to be spanned on the edge of a township were large. Surveyors tried to prevent overly large government lots (more than 60 acres). This dilema was solved by creating additional government lots to fill the space. An example of these additional lots is shown in lots 5, 8, and 9 of Figure 6. These extra lots are termed "irregular parcels" in the jargon of the MLMIS staff. Figure 1 indicates the location of concentrations of irregular parcels in Minnesota (page 4).

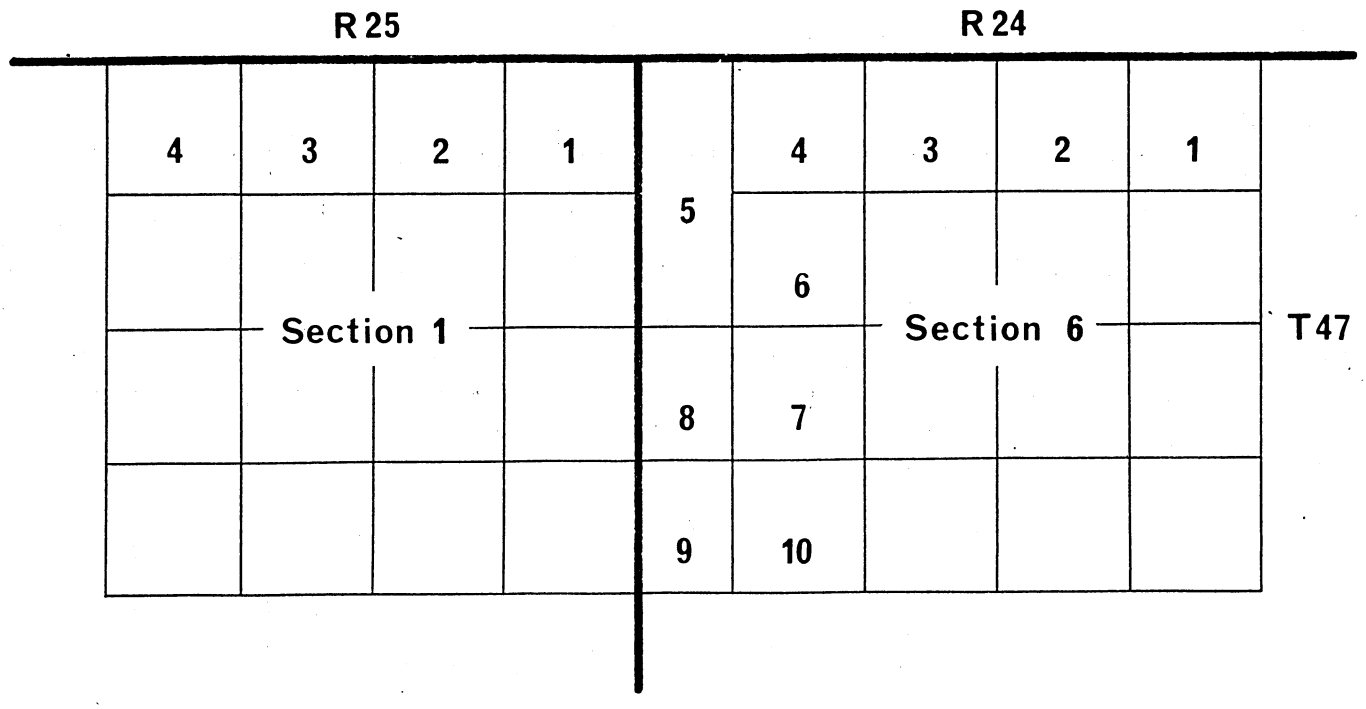

Figure 6: Government Lots on Township Borders – "irregular parcels"

C. Distortions

The preceding section defines the PLS as a thoroughly orderly system. In fact this is not always true. Errors due to swamps, magnetic deviations, and other factors have become a part of the landscape and are a reality which must be dealt with. Distorted townships are not square and sometimes do not have straight sides. Nevertheless, these townships do tend to have regularly named parcels within them, though a full complement of parcels may not exist. Figure 1 indicates areas of Minnesota where these distortions become most noticeable (page 4).

III. MLMIS GEOCODE FORMAT

From the PLS system described above, MLMIS has developed a 14 digit parcel identifier. Table 1 details the use of each digit in the MLMIS parcel identifier. Each digit in the identifier sequence refers to a particular locational characteristic of the parcel. Details on each element of the code are discussed below.

TABLE 1: MLMIS PARCEL GEOCODE FORMAT

Digit	PLS Unit
1- 2	County Number
3- 5	Township Number
6- 7	Range Number
8	Range Direction
9-10	Section Number
11-12	40 Code
13-14	Government Lot Number (if any)

A. County Code

The MLMIS county code is the same as that used by the Bureau of Census in 1960: a sequential numbering of the alphabetized county list. These codes are shown in Table 2.

Although county designation is not an integral part of the PLS scheme, it is nonetheless important to public officials who constantly deal with politically defined units of land. Therefore, our files are organized first by county, then by townships and parcels within the county.

TABLE 2: MINNESOTA COUNTIES AND NUMBERS

1. Aitkin
2. Anoka
3. Becker
4. Beltrami
5. Benton
6. Big Stone
7. Blue Earth
8. Brown
9. Carlton
10. Carver
11. Cass
12. Chippewa
13. Chisago
14. Clay
15. Clearwater
16. Cook
17. Cottonwood
18. Crow Wing
19. Dakota
20. Dodge
21. Douglas
22. Faribault
23. Fillmore
24. Freeborn
25. Goodhue
26. Grant
27. Hennepin
28. Houston
29. Hubbard
30. Isanti
31. Itasca
32. Jackson
33. Kanabec
34. Kandiyohi
35. Kittson
36. Koochiching
37. Lac Qui Parle
38. Lake
39. Lake of the Woods
40. Le Sueur
41. Lincoln
42. Lyon
43. McLeod
44. Mahnomen
45. Marshall
46. Martin
47. Meeker
48. Mille Lacs
49. Morrrison
50. Mower
51. Murray
52. Nicollet
53. Nobles
54. Norman
55. Olmsted
56. Ottertail
57. Pennington
58. Pine
59. Pipestone
60. Polk
61. Pope
62. Ramsey
63. Red Lake
64. Redwood
65. Renville
66. Rice
67. Rock
68. Roseau
69. St. Louis
70. Scott
71. Sherburne
72. Sibley
73. Stearns
74. Steele
75. Stevens
76. Swift
77. Todd
78. Traverse
79. Wabasha
80. Wadena
81. Waseca
82. Washington
83. Watonwan
84. Wilkin
85. Winona
86. Wright
87. Yellow Medicine

B. Township and Range Codes

Township and range codes are based on original survey numbers. The MLMIS code was derived by simply transferring the original survey numbers to the data file. The township number becomes digits 3-5 and the range number digits 6-7 of the MLMIS geocode, with the range's location east or west of the appropriate principal meridian coded in digit 8 according to the scheme shown in Table 3.

TABLE 3: MLMIS CODE FOR RANGE DIRECTION

Code	Direction from Principal Meridian
1	East
2	West

C. Section Codes

Section codes are also based on the original survey numbers (1-36). The section number becomes digits 9-10 of the MLMIS geocode.

D. Codes for Subdivisions of a Section

All parcels are coded with both a "40" code and a government lot number in the MLMIS scheme. A two-digit "40" code is assigned to each quarter-quarter section. The first digit applies to the first quartering and the second digit to the second quartering. Table 4 indicates the code scheme, and Figure 7 is a spatial representation of the quarter-quartering of a section. These codes

become the 11th and 12th digits of the MLMIS geocode scheme. Applying this scheme in Figure 3, the shaded parcel in section 17 would be coded 13 (NE quarter, SW quarter-quarter).

TABLE 4: MLMIS CODES FOR GENERATING 40 CODES FROM SECTION QUARTERING

Code	Quarter
1	NE
2	NW
3	SW
4	SE

22	21	12	11
23	24	13	14
32	31	42	41
33	34	43	44

Figure 7: Parcel Coding Scheme

The "40" code scheme indicates the relative location of a parcel within a section, but the scheme is dependent upon the regular quarter-quartering of each section.[4] Government lots do

[4] Computer programs have been developed at MLMIS to locate and map parcels based on this "40" code.

not necessarily correspond to such a regular grid pattern. Because of this discrepancy "40" codes are assigned to government lots to indicate their relative locations. A regular grid is laid over the section map containing government lot(s), and the appropriate location code is determined as if the section had been regularly subdivided. If a government lot covers more than one quarter-quarter grid parcel, it is coded into multiple "40" grid parcels.

The government lot number from the original PLS survey becomes the 13 and 14th digits of the MLMIS geocode. Regular parcels which are not government lots are coded 00 for these digits.

Figure 8 shows the method by which 16 parcels are carved out of a section containing four government lots and 11 regular 40's. The four digits in each parcel of Figure 8 are positions 11-14 in the fourteen digit parcel identifier. Note that government lot 4 has been subdivided into two separate parcels.

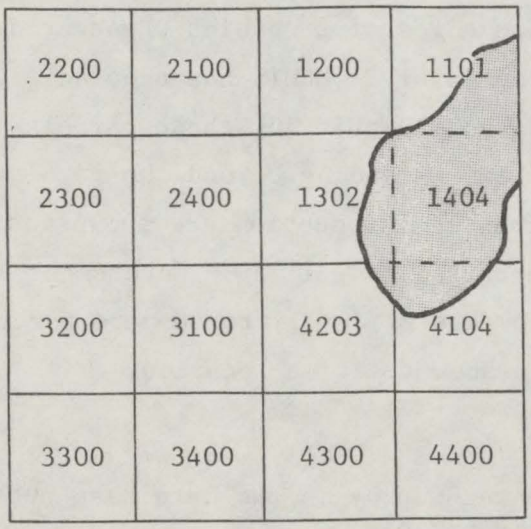

Figure 8: Parcel Coding Scheme with Government Lots [See figure 4 for PLS designation]

Occasionally some quarter-quarter grid parcels contain more than one government lot. In this case multiple parcels are coded for entry into the MLMIS data base.[5] Figure 9 indicates this methodology in the Northeast quadrant of a section.

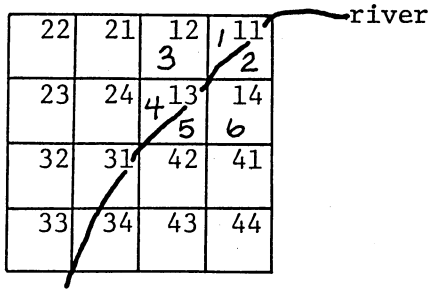

Figure 9: Subdividing Parcels with Multiple Government Lots

The reader will recall that one other kind of government lot exists, the irregular parcel, which is located outside the regular section and is used primarily to fill spaces along the northern and western edges of townships whenever a meridian correction jog is necessary. MLMIS has adopted a grid numbering scheme for locating and identifying those parcels. Figure 10 shows this code scheme extending beyond the regular section.[6] The 16 "40's" of the regular section are shown inside the darker section boundary in Figure 10. Government lots outside the section boundary are gridded into 40 acre parcels and coded as per Figure 10 to show relative location.

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[5] This causes some redundancy in the data base but only one parcel is mapped per grid parcel.

[6] The DNR Land Classification System uses the same scheme except parcel "10" is coded "00." This is consistent with having each digit specify placement, but causes confusion with government lots which may not have been assigned a 40 location code.

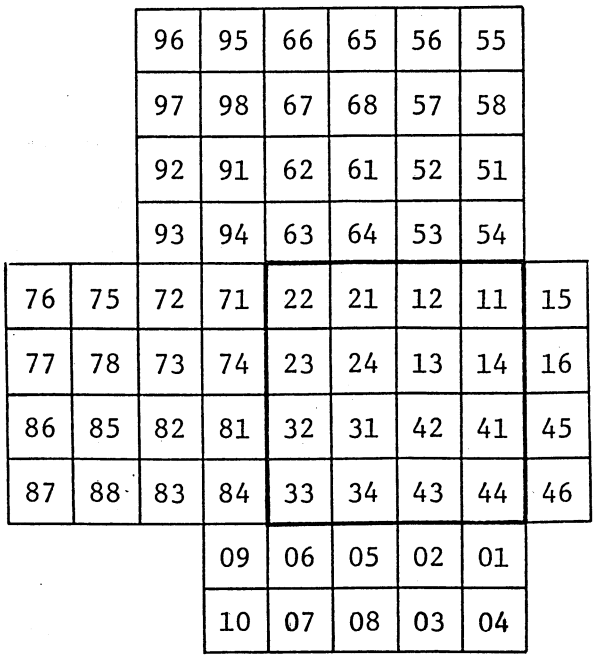

Figure 10: Code Scheme for Parcels Outside the Regular Section

The basic reference used for this work is the series of 1:48,000 County Highway Maps prepared in 1936 by the State Highway Department. These maps, found in the Map Division of Wilson Library on the Minneapolis Campus of the University of Minnesota, indicate the location of all government lots within sections. This source is the most recent documentation of the survey statewide. The few re-surveys that have been conducted since that date are documented only in county records and are not found in any central file.

IV. GEOPOLITICAL CODES

The three political units of most concern within the state of Minnesota are counties, minor civil divisions (MCD's), and school districts. MLMIS adds these identifiers to each parcel record. These identifiers allow summaries of land related information to be made to the selected political unit level with a minimum of effort. Similarly, data relevant to this political unit, e.g. tax mill rate, can be easily applied to the parcel level data.

Until recently, counties were the next level of government below the state. Thirteen multi-county regional development commissions have been added to this system, but they are not governing bodies, so MLMIS retains counties as the basic unit of organizing its data.

A. County Codes

The codes assigned to counties are taken from the 1960 Census of Population. These codes are shown in Table 2 (page 12). The codes are sequential numbers assigned to the alphabetically arranged counties. The slightly different 1970 Census codes also exist in the MLMIS file, but are of secondary importance. Figure 11 is a map of Minnesota's 87 counties with the codes identified.

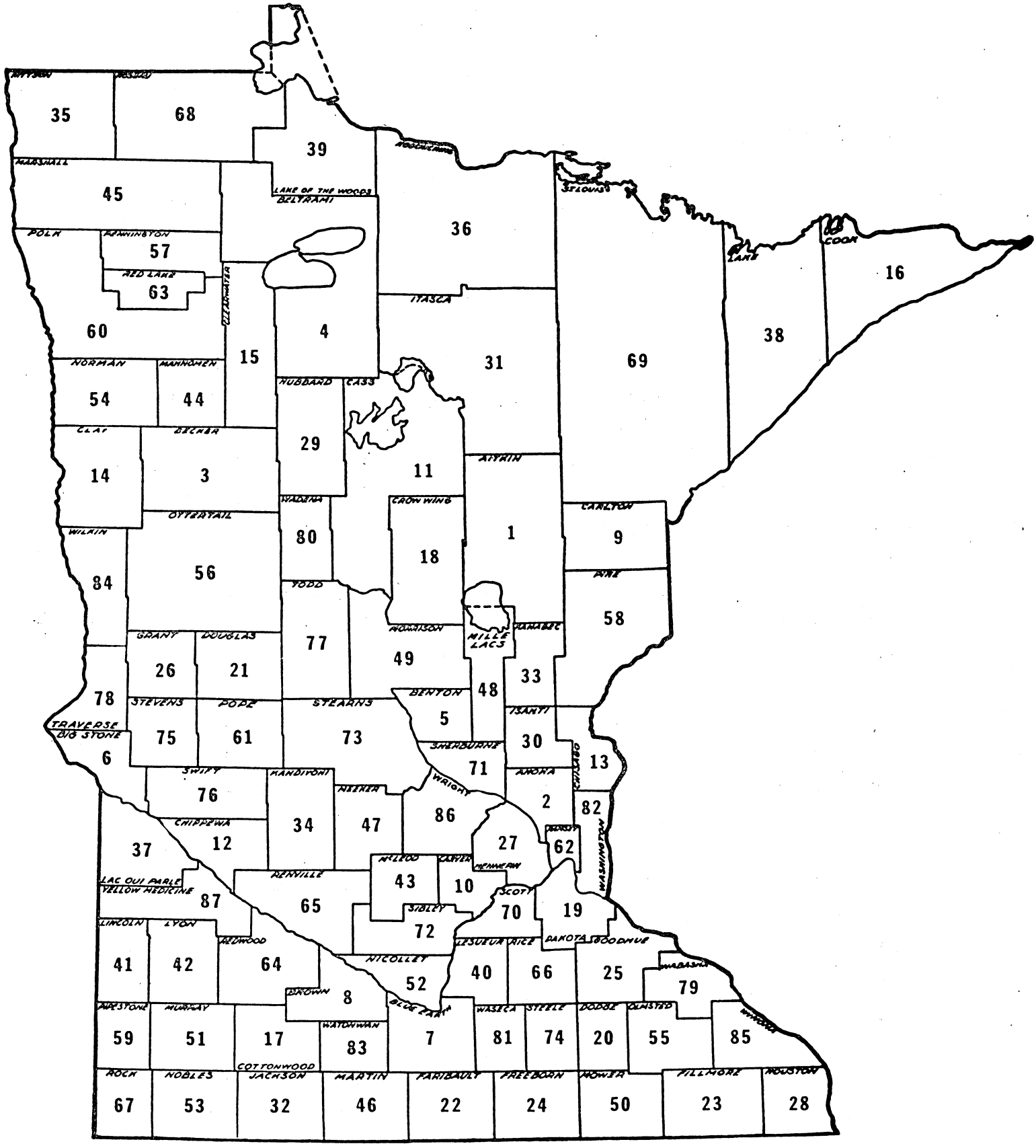

Figure 11: Minnesota County Numbers

B. Code for Minor Civil Divisions (MCD)

The political subdivision of counties employed by MLMIS is the MCD, which includes such subdivisions as townships, cities,[7] and unorganized territories. The source of the codes is the Geographic Identification Code Scheme issued by the Census Bureau.

As an example, the 1970 MCD's of Itasca County are shown in Figure 12. Itasca has one of the most complex MCD structures of all Minnesota counties. Cities and villages are typed with an initial capital letter and all remaining letters in lower case letters. Townships are designated with all captial letters. The unorganized territories of the county are assigned unique names. Where an MCD is split, e.g. Morse Township, the separate parts are noted and labeled. Cities or villages which have not been separated from their parent township are shown with unique boundaries: dashed lines (Grand Rapids village) or circles (e.g., LaPrairie Village).

In assigning codes, the Census Bureau alphabetizes the MCD's within a county and numbers them. In 1960 the MCD's were numbered beginning with the numeral one and incremented by one. This system led to problems. Whenever new MCD's were incorporated or when names changed, the whole sequence had to be changed. To allow flexibility, 1970 MCD codes were begun with the numeral five and incremented by five (Table 5). For stable places the 1970 code is a 5-fold multiple of the 1960 code. New MCD codes can be assigned within the alphabetical order by choosing a number not a multiple of 5. Note that unseparated places have the same MCD code as their parent township.

Some cities cross county borders. In such a case, the city is assigned multiple MCD numbers, since it forms a subdivision of

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[7] Since 1970, all incorporated MCD's have been designated cities.

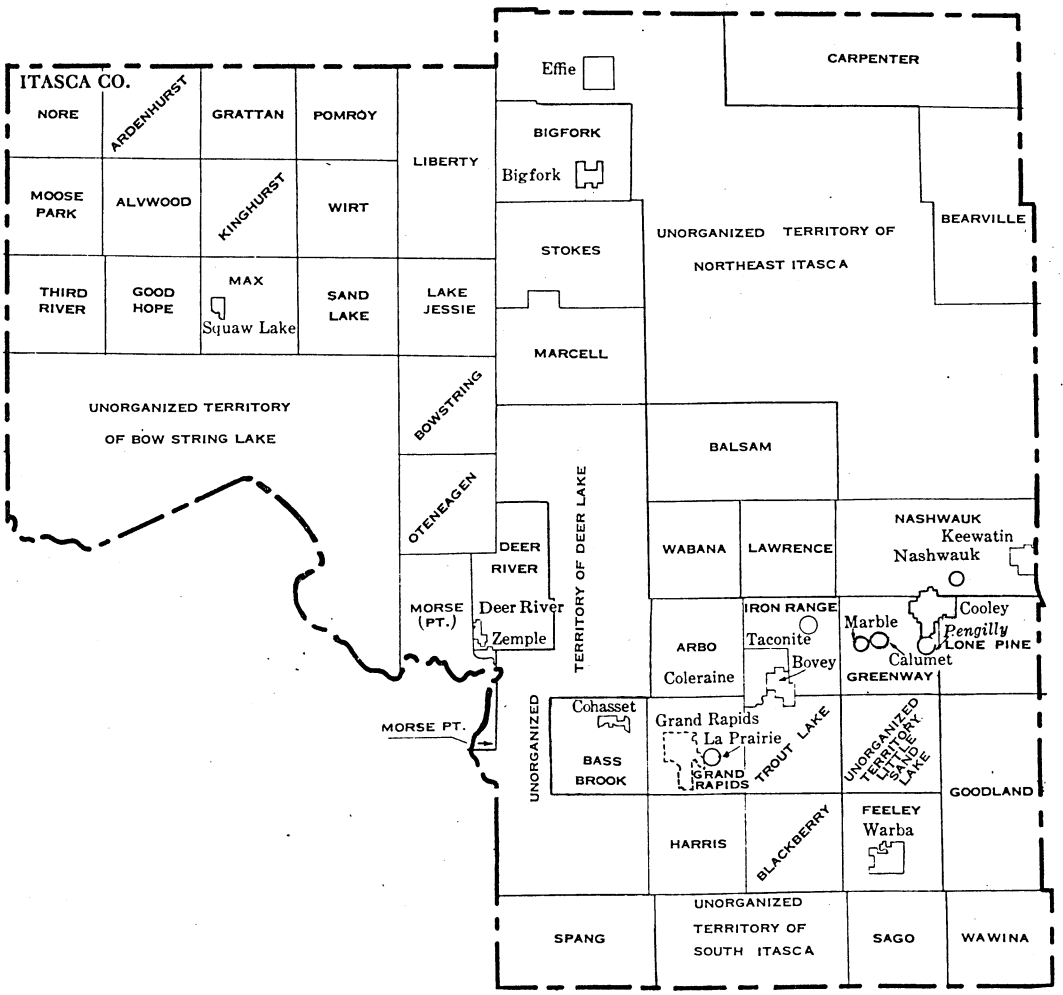

Figure 12: Itasca County Minor Civil Divisions, 1970

different counties. The Census Bureau handles this problem by assigning a unique place code to each incorporated area. For example, the City of St. Cloud is place 3380 by the 1970 Census code scheme, but it is MCD 230 of Stearns County, MCD 65 of Benton County, and MCD 75 of Sherburne County. MLMIS does not use place codes, since they only apply to cities.

The areal extent of MCD's was taken from the County Map Series of the 1970 Census. Changes in boundaries, including annexations and incorporations, should be monitored by the Minnesota Municipal Commission (MMC), but at this time the MMC has neither the charge nor the personnel to adequately handle this work.

TABLE 5: MCD'S WITHIN ITASCA COUNTY

MCD Name	1960 MCD Number	1970 MCD Number	MCD Name	1960 MCD Number	1970 MCD Number
Alvwood	001	005	Kinghurst	028	140
Arbo	002	010	Lake Jessie	029	145
Ardenhurst	003	015	Lawrence	030	150
Balsam	004	020	Liberty	031	155
Bass Brook	005	025	Lone Pine	032	160
Bearville	006	030	Marcell	033	165
Bigfork	007	035	Max	034	170
Bigfork Vil.	008	040	Moose Park	035	175
Blackberry	009	145	Morse	036	180
Bovey Vil.	010	050	Nashwauk	037	185
Bowstring	011	055	Nashwauk Vil.	037	185
Carpenter	012	060	Nore	038	190
Cohasset Vil.	013	065	Oteneagen	039	195
Coleraine Vil.	014	070	Pomroy	040	200
Cooley Vil.	015	075	Sago	041	205
Deer River	016	080	Sand Lake	042	210
Deer River Vil.	017	085	Spang	043	215
Effie Vil.	018	090	Squaw Lake Vil.	044	220
Feeley	019	095	Stokes	045	225
Good Hope	020	100	Third River	046	230
Goodland	021	105	Trout Lake	047	235
Grand Rapids	022	110	Wabana	048	240
Grand Rapids Vil.	022	110	Warba Vil.	049	245
La Praire Vil.	022	110	Wawina	050	250
Grattan	023	115	Wirt	051	255
Greenway	024	120	Zemple Vil.	052	260
Calumet Vil.	024	120	Unorganized Territory	053	
Marble Vil.	024	120	(Bowstring Lake)		(265)
Harris	025	125	(Deer Lake)		(270)
Iron Range	026	130	(Little Sand)		(275)
Taconite Vil.	026	130	(Northeast Itasca)		(280)
Keewatin Vil.	027	135	(South Itasca)		(285)

NOTE: Unless otherwise noted, each MCD is a township.

C. School District Codes

School districts are labeled with their unique district numbers determined by the Minnesota Department of Education. The areal extent of each district was determined from the Atlas of Minnesota School Districts, prepared by Branko Colakovic, Department of Geography, Mankato State University in 1972. Recently this information has been updated and corrected. The current source for determining school district location and areal extent is found in the Atlas of Minnesota Taxing Jurisdictions.

BIBLIOGRAPHY

American National Standards Institute, "Structure for the Identification of Named Population Places and Related Entities of the States of the United States."

Colakovic, Branko, Atlas of Minnesota School Districts, the Blue Earth County Geographical Society, Mankato, Minnesota, 1972.

Lee, Jim J., Atlas of Minnesota Taxing Jurisdictions, Center for Urban and Regional Affairs, University of Minnesota, Minneapolis, Minnesota, 1975.

Orning, George W. and Maki, Les, Land Management Information in Northwest Minnesota: the Beginning of a Statewide System, MLMIS Report Number 1, 1972.

State of Minnesota, Proposed Geocoding Standards for Purposes of Information Interchange Work Remaining to be Done in the Geocoding Area, draft report by the Geocoding Committee of the state's Intergovernmental Information Systems Advisory Council, November 1973.

U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1967.

U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1972.

U.S. Department of Commerce, Bureau of the Census, County Map for Minnesota, 1970.

U.S. Department of Commerce, Bureau of the Census, Geographic Identification Code Scheme, Minnesota, PHC (2)-25, Washington D.C., 1961.

U.S. Department of Commerce, Bureau of the Census, Geographic Identification Code Scheme, North Central Region, PHC (R)-3, Washington D.C., 1971.

U.S. Department of Commerce, Bureau of the Census, MCD Map of Minnesota, Washington D.C., 1970.

Werner, Pamela A., A Survey of National Geo-coding Systems, Department of Transportation, Washington D.C., February 1972.